

Technical English

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Chapter 3: EVAPORATORS

OBJECTIVES

After studying this unit, you should be able to

- define high-, medium-, and low-temperature refrigeration.
- determine the boiling temperature in an evaporator.
- identify different types of evaporators.
- describe a parallel-flow, plate-and-fin evaporator.
- describe multiple- and single-circuit evaporators.

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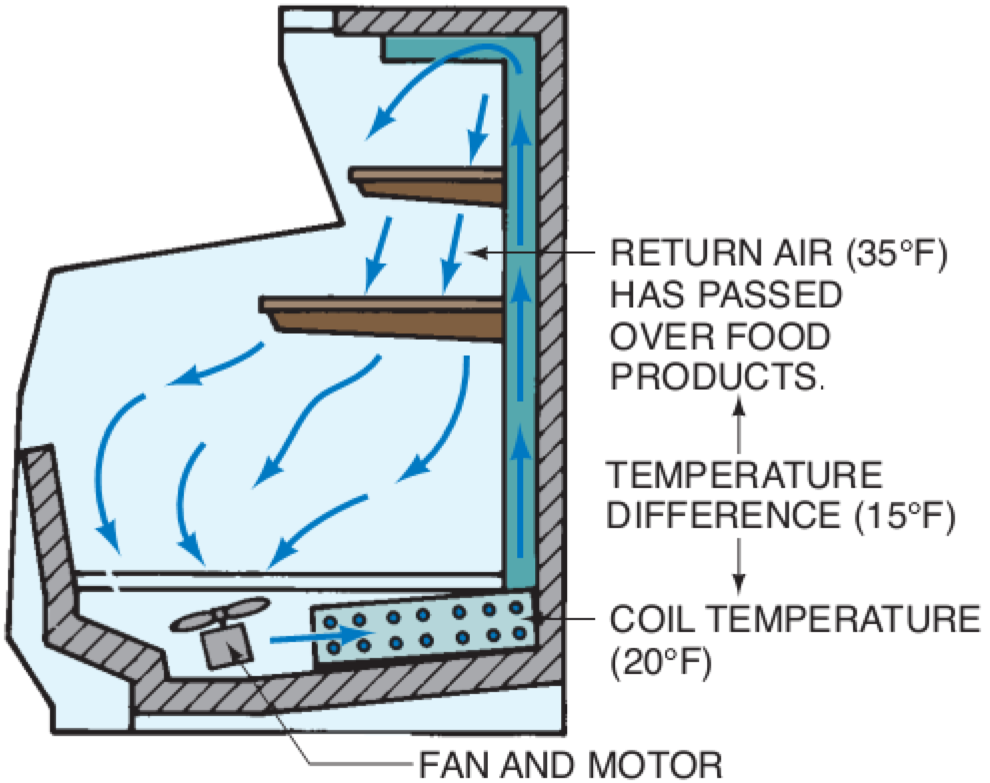
The evaporator in a refrigeration system is responsible for absorbing heat into the system from whatever medium is to be cooled. This heat- absorbing process is accomplished by maintaining the evaporator coil at a lower temperature than the medium to be cooled.



THE COMPRESSOR IS RUNNING — THIS LOWERS COIL TEMPERATURE.

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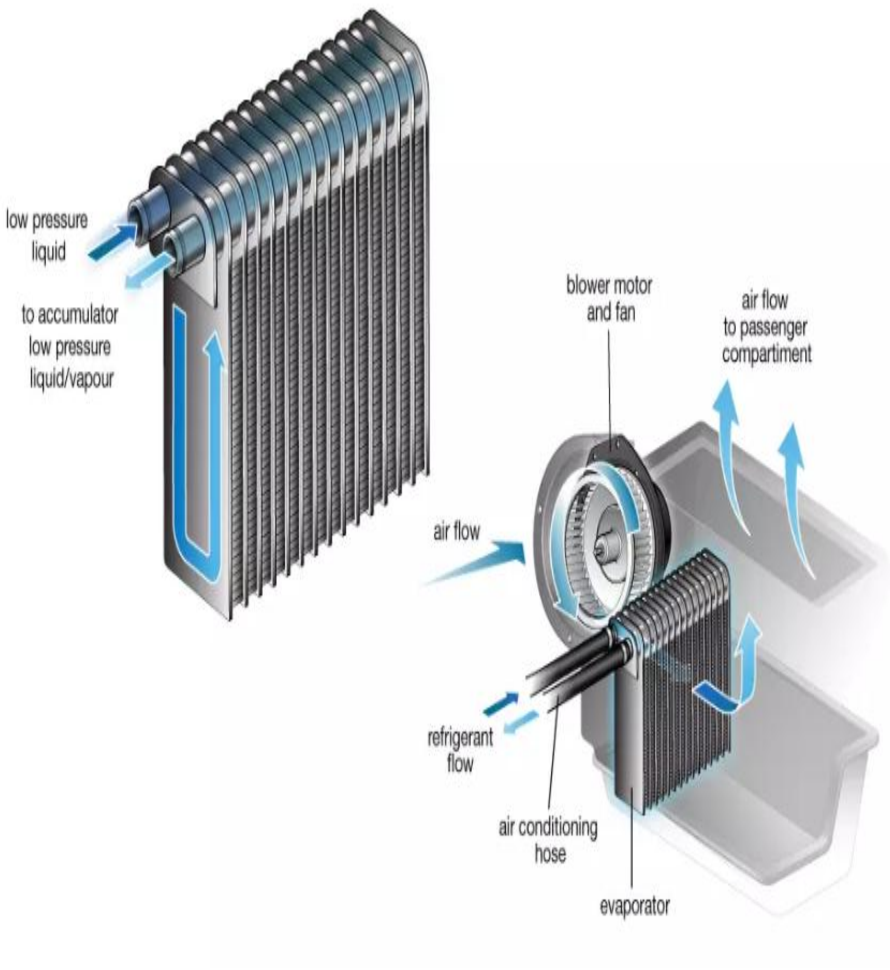
The evaporator removes heat from the space being cooled. As the air is cooled, it condenses water vapor. This must be drained. If the water condensing on the evaporator coil freezes when the temperature is below 32°F (0°C), the refrigerator or freezer must work harder. Frozen water or ice acts as an insulator. It reduces the efficiency of the evaporator. When evaporators are operated below 32°F, they must be defrosted periodically. This eliminates frost buildup on the coils or the evaporator plates.



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There are several types of evaporators:

- The coiled evaporator is used in warehouses for refrigerating large areas.
- The fin evaporator is used in the air-conditioning system that is part of the furnace in a house.
- Plate evaporators use flat surfaces for their cooling surface.

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COILED EVAPORATOR

Evaporator coils on air-conditioning units fall into two categories:

- Finned-tube coil.The finned-tube coil is placed in the air stream of the unit. Refrigerant vaporizes in it. The refrigerant in the tubes and the air flowing around the fins attached to the tubes draw heat from the air. This is commonly referred to as a direct expansion cooling system.

- Shell-and-tube chiller.Shell-and-tube units are used to chill water for air-cooling purposes. Usually, the refrig-erant is to tubes mounted inside a tank or shell containing the water or liquid to be cooled. The refrigerant in the tubes draws the heat through the tube wall and from the liquid as it flows around the tubes in the shell. This system can be reversed. Thus, the water would be in the tubes and the refrigerant would be in the tank. As the gas passes through the tank over the tubes, it would draw the heat from the water in the tubes.

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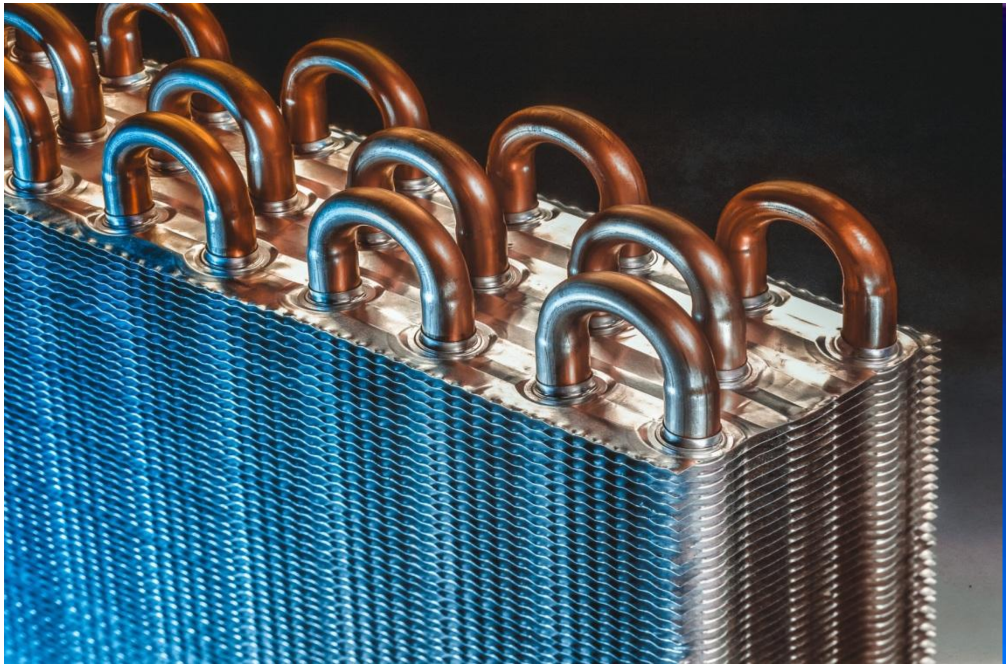

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COILED EVAPORATOR

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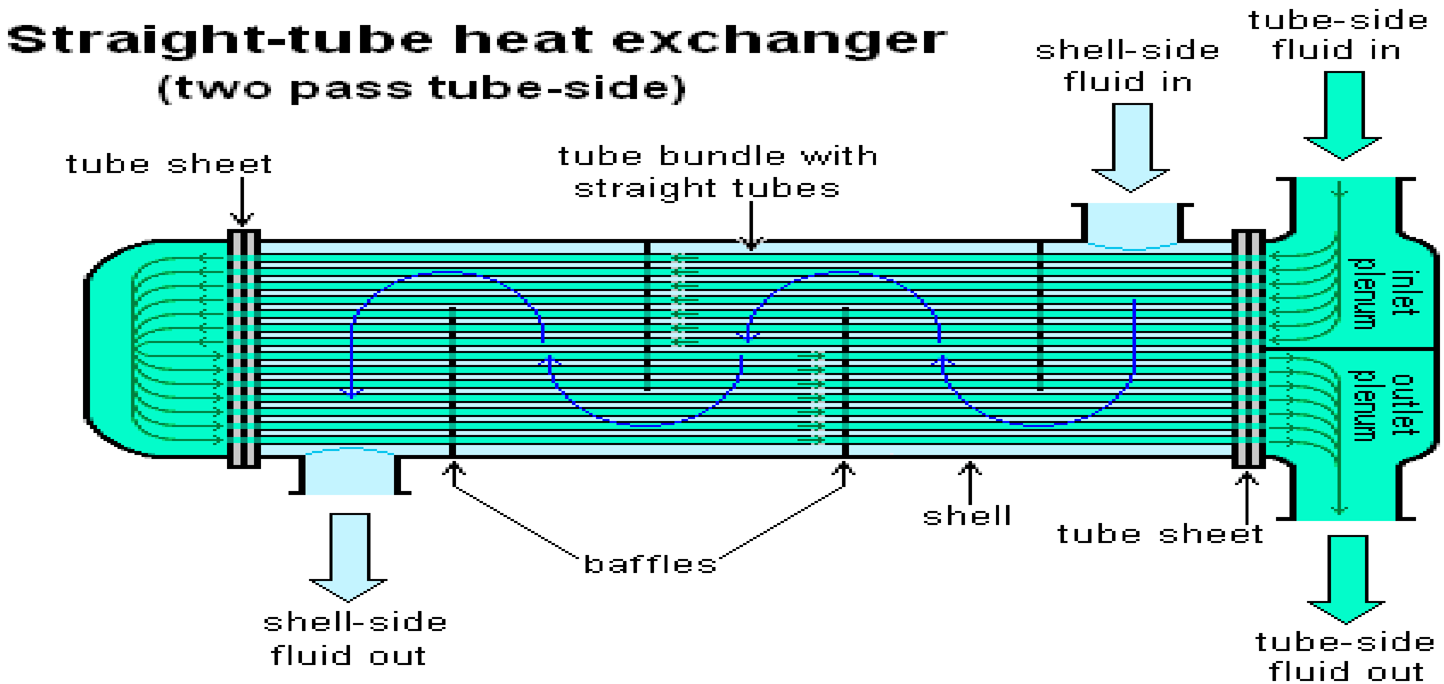

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LATENT HEAT IN THE EVAPORATOR

The latent heat absorbed during the change of state is much more concentrated than the sensible heat that would be added to the vapor leaving the coil.

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THE FLOODED EVAPORATOR

To get the maximum efficiency from the evaporator heat exchange, some evaporators are operated full of liquid, or flooded, and are equipped with a device to keep the liquid refrigerant from passing to the compressor.

These flooded evaporators are specially made and normally use a float metering device to keep the liquid level as high as possible in the evaporator. This text will not go into detail about this system because it is not a device often encountered. The manufacturer's literature should be consulted for any special application. When an evaporator is fl ooded, it would operate much like water boiling in a pot with a compressor taking the vapor off the top of the liquid. There would always be a liquid level. If the evaporator is not fl ooded, that is, when the refrigerant starts out as a partial liquid and boils away to a vapor in the heat exchange pipes, it is known as a dry-type, or direct- expansion, evaporator.

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DRY-TYPE EVAPORATORS PERFORMANCE

To check the performance of a dry-type evaporator, the service technician would first make sure that the refrigerant coil is operating with enough liquid inside the coil.

To determine this, the technician must calculate the evaporator superheat. This is generally done by comparing the boiling temperature of the refrigerant inside the coil with the line temperature leaving the coil. The difference in temperatures is usually 8°F to 12°F.

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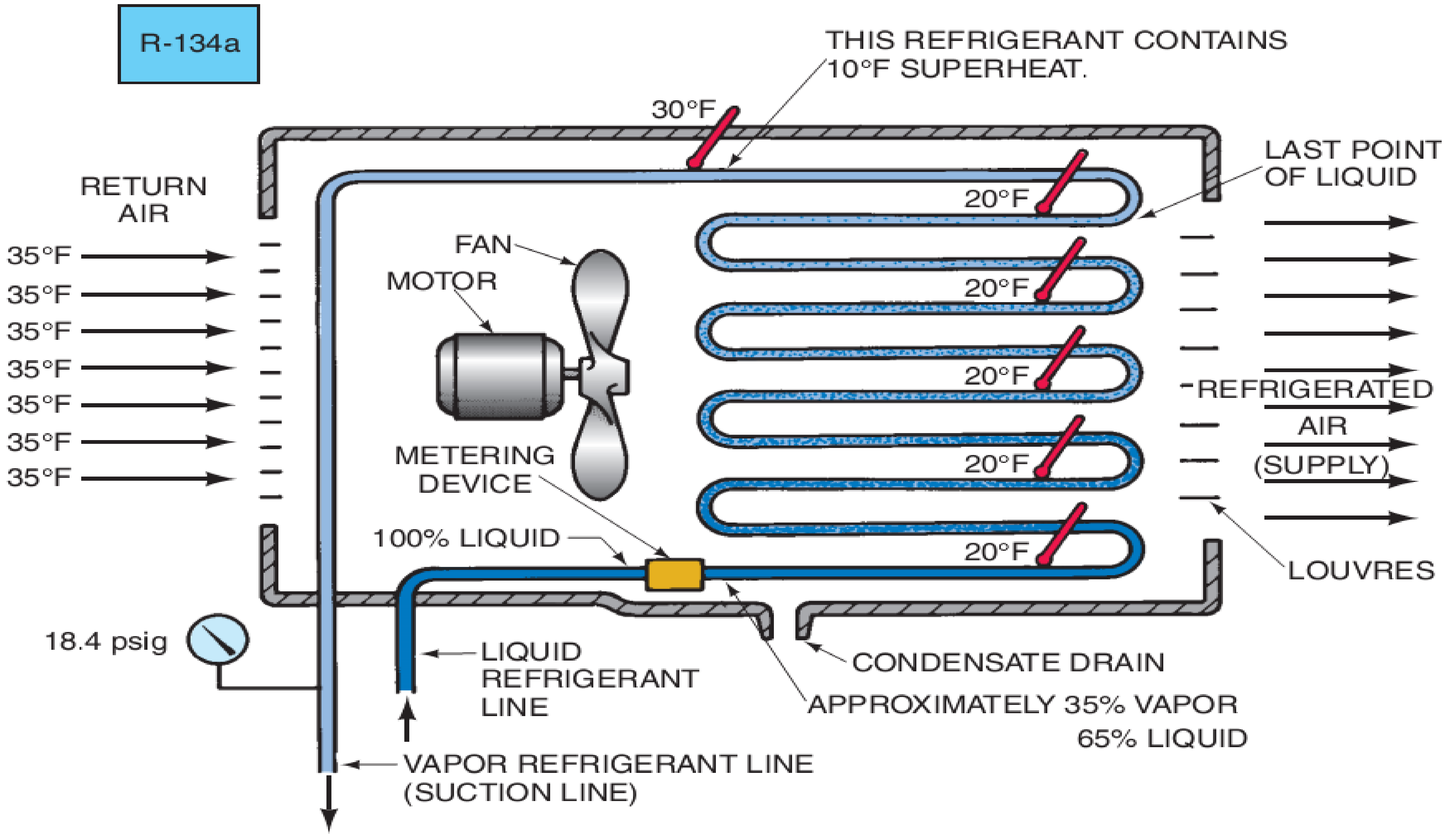

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EVAPORATOR SUPERHEAT

The difference in temperature between the boiling refrigerant temperature and the evaporator outlet temperature is known as evaporator superheat.

Superheat is the sensible heat added to the vapor refrigerant after the change of state has occurred. Superheat is the best method of checking to see when a refrigerant coil has a proper level of refrigerant.

When a metering device is not feeding enough refrigerant to the coil, the coil is said to be a starved coil,and the super-heat is greater

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It can be seen from the example that all of the refrigeration takes place at the beginning of the coil. The suction pressure is very low, below freezing, but only a portion of the coil is being used effectively. This coil would freeze solid and no air would pass through it.

The freeze line would creep upward until the whole coil was a block of ice, and the refrigeration would do no good. The refrigerated box temperature would rise because ice is a good insulator.

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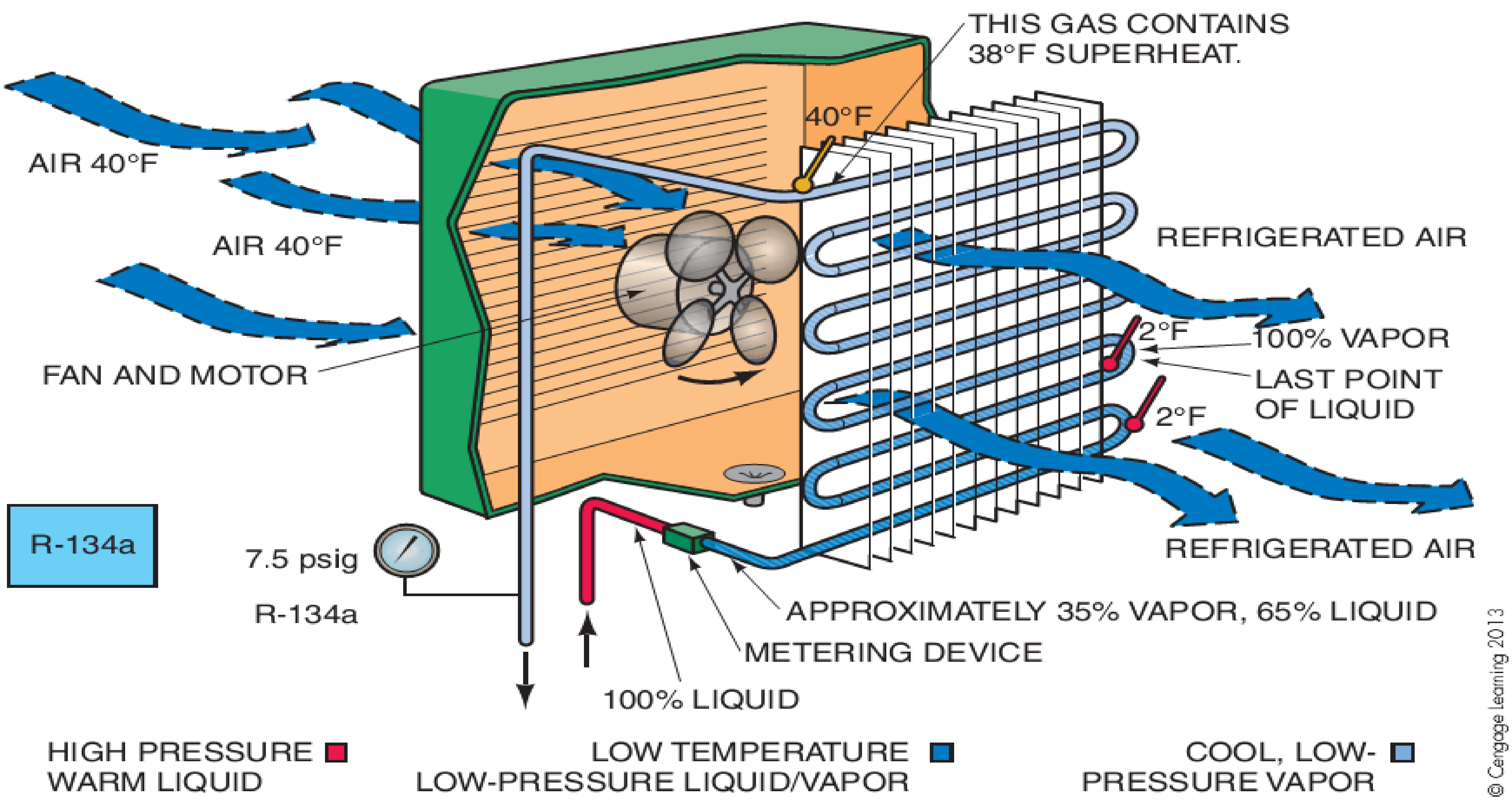

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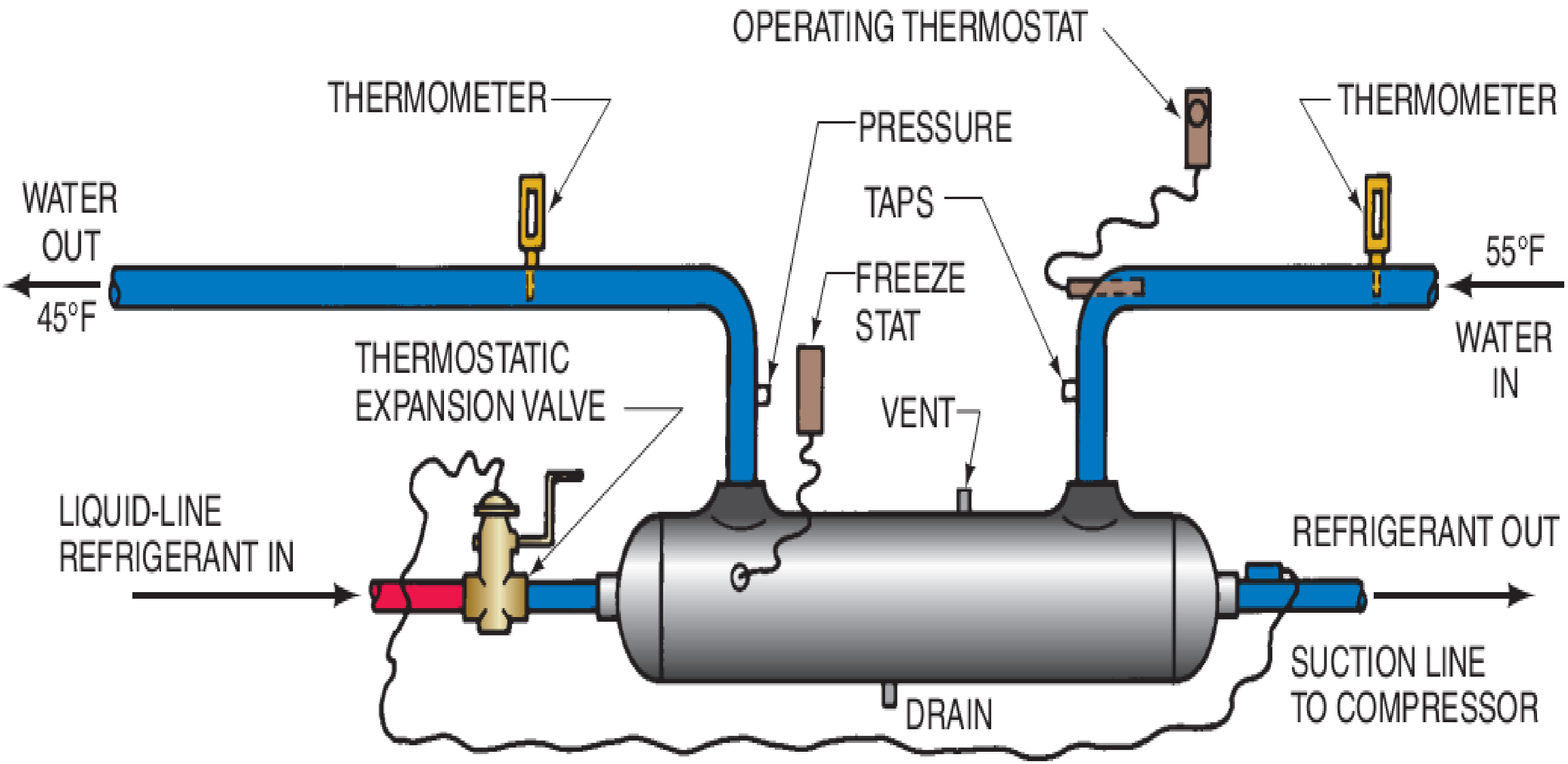
LIQUID COOLING EVAPORATORS (CHILLERS)



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A different type of evaporator is required for liquid cooling. It functions much like the one for cooling air and is normally a dry-type expansion evaporator in smaller systems.

Evaporators for larger-tonnage chillers are usually the flooded type. They have saturated liquid/vapor refrigerant in the shell and the water to be chilled flows in the tube bundles. They use a low side float to meter the refrigerant into the shell of the evaporator to maintain the proper refrigerant level.

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Liquid cooling evaporators have more than one refrigerant circuit to prevent pressure drop. These evaporators sometimes have to be checked to see whether they are absorbing heat as they should.

Using refrigeration gauges and some accurate method for checking the temperature of the suction line are very important.

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EVAPORATORS FOR LOW-TEMPERATURE APPLICATIONS

Low-temperature evaporators used for cooling space or product to below freezing are designed differently because they require the coil to operate below freezing. In an airflow application, the water that accumulates on the coil will freeze and will have to be removed.

The design of the fin spacing must be carefully chosen, because a very small amount of ice accumulated on the fins will restrict the airflow. Low-temperature coils have fin spacings that are wider than medium-temperature coils.

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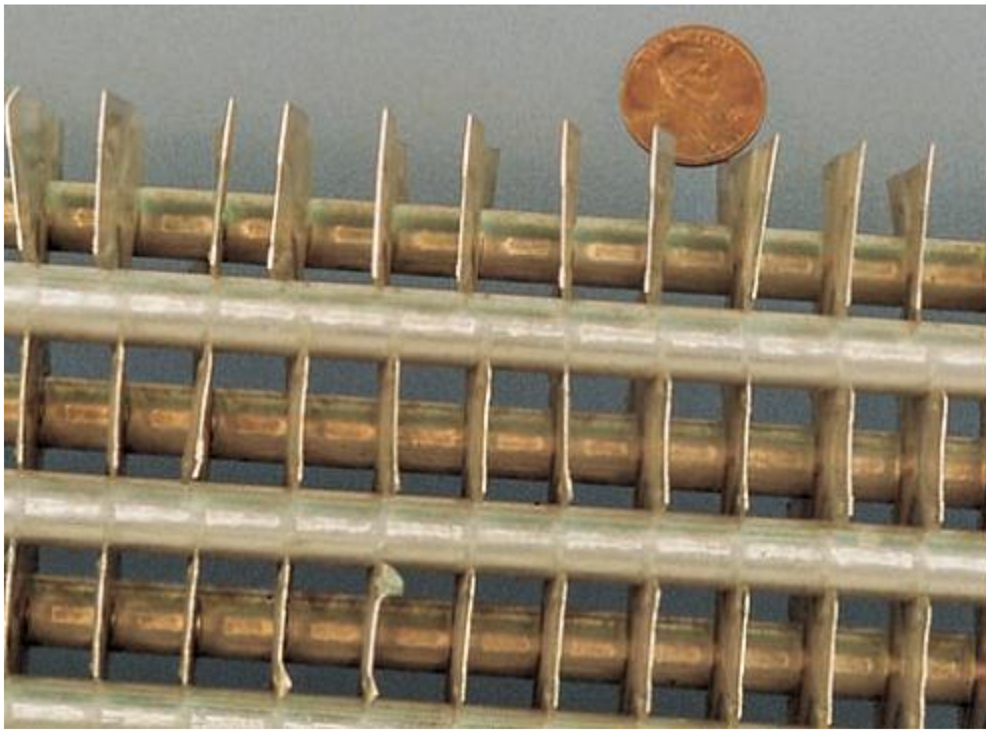

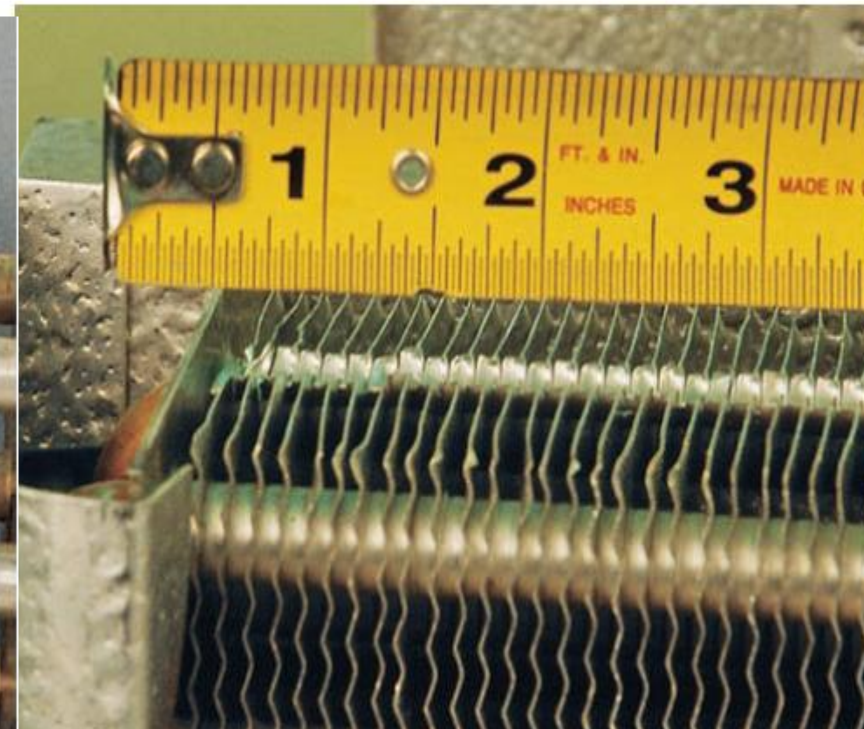

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DEFROST OF ACCUMULATED MOISTURE

Defrost can be accomplished with heat from inside the system using the hot g from the discharge line of the compressor by routing a hot gas line from t compressor discharge line to the outlet of the expansion valve and installing solenoid valve to control the flow. When defrost is needed, hot gas is releas inside the evaporator, which will quickly melt any ice. When the hot gas enters t evaporator, it is likely that liquid refrigerant will be pushed out of the suction li toward the compressor. In fact, when hot gas enters an evapo-rator and starts cool as it melts ice or frost, it will soon lose all of its superheat and turn to liquid condense. This liquid will go to the accumulator and fall to its bottom. Den saturated vapors will be drawn into the compressor's suction stroke. T compressor will see an increased load from these dense vapors and may draw higher amp than during the normal running cycle. If the system does not have accumulator, this condensed liquid may flood the compressor's crankcase a foaming of the oil in the crankcase may occur

Thank You !